

Appln. Serial No. 09/806,756  
Amendment Dated July 26, 2005  
Reply to Office Action Mailed June 7, 2005

### AMENDMENTS TO THE CLAIMS

This listing of claims replaces all prior versions, and listings, of claims in the application:

- 1 1. (Currently Amended) Method for detecting voice activity in a digital speech signal in at  
2 least one frequency band, wherein the voice activity is detected on the basis of an analysis  
3 comprising the step of comparing two different versions of the speech signal, wherein ~~at least~~  
4 ~~one of said versions is a denoised version obtained by taking account of estimates of noise~~  
5 ~~included in the signal~~ the two different versions of the speech signal are two versions denoised  
6 by non-linear spectral subtraction, wherein a first of the two versions is denoised in such a way  
7 as not to be less, in the spectral domain, than a first fraction of a long-term estimate  
8 representative of a noise component included in the speech signal, and the second of the two  
9 versions is denoised in such a way as not to be less, in the spectral domain, than a second  
10 fraction of said long-term estimate, smaller than said first fraction.
- 1 2. (Previously Presented) Method according to claim 1, wherein said comparison is  
2 performed on respective energies, evaluated in said frequency band, of the two different versions  
3 of the speech signal, or to a monotonic function of said energies.
- 1 3. (Previously Presented) Method according to claim 1, wherein said analysis further  
2 comprises a time smoothing of the energy of one of said versions of the speech signal, and a  
3 comparison between the energy of said version and the smoothed energy.
- 1 4. (Previously Presented) Method according to claim 3, wherein the comparison between  
2 the energy of said version and the smoothed energy controls transitions of a voice activity  
3 detection automaton from a speech state to a silence state, and wherein the comparison of the  
4 two different versions of the speech signal controls transitions of the detection automaton from  
5 the silence state to the speech state.
- 1 5. (Cancelled)

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1 6. (Currently Amended) Method according to claim [[5]] 1, wherein said analysis further  
2 comprises a time smoothing of the energy of each of the two versions of the speech signal, by  
3 means of a smoothing window determined by comparing the energy of the second of the two  
4 versions with the smoothed energy of the second of the two versions.

1 7. (Previously Presented) Method according to claim 6, wherein the smoothing window is  
2 an exponential window defined by a forgetting factor.

1 8. (Previously Presented) Method according to claim 7, comprising the step of allocating a  
2 substantially zero value to the forgetting factor when the energy of the second of the two  
3 versions is less than a value of the order of the smoothed energy of the second of the two  
4 versions.

1 9. (Previously Presented) Method according to claim 8, comprising the step of allocating a  
2 first value substantially equal to 1 to the forgetting factor when the energy of the second of the  
3 two versions is greater than said value of the order of the smoothed energy multiplied by a  
4 coefficient bigger than 1, and allocating a second value lying between 0 and said first value to  
5 the forgetting factor when the energy of the second of the two versions is greater than said value  
6 of the order of the smoothed energy and less than said value of the order of the smoothed energy  
7 multiplied by said coefficient.

1 10. (Currently Amended) Method according to claim [[5]] 1, wherein the first and second  
2 fractions correspond substantially to attenuations of 10 dB and 60 dB, respectively.

1 11. (Previously Presented) Method according to claim 1, wherein the comparison of the two  
2 different versions of the speech signal is performed on respective differences between the  
3 energies of said two versions in said frequency band and a lower bound of the energy of the  
4 denoised version of the speech signal in said frequency band.

1 12. (Cancelled)

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13. (Currently Amended) Device for detecting voice activity in a speech signal, comprising signal processing means for analyzing the speech signal in at least one frequency band, wherein the processing means comprise:

- first non-linear spectral subtraction means to provide a first version of the speech signal as a denoised version which is not less, in the spectral domain, than a first fraction of a long-term estimate representative of a noise component included in the speech signal;

- second non-linear spectral subtraction means to provide a second version of the speech signal as a denoised version which is not less, in the spectral domain, than a second fraction of said long-term estimate, said second fraction being smaller than said first fraction; and

- means for comparing two different the first and second versions of the speech signal, wherein at least one of said versions is a denoised version, obtained by taking account of estimates of noise included in the signal.

14. - 15. (Cancelled)

16. (Currently Amended) Device according to claim 13, wherein the processing means comprise means for evaluating, in said frequency band, energies of said ~~two different~~ first and second versions of the speech signal, whereby inputs of the comparison means comprise said energies or a monotonic function of said energies.

17. (Currently Amended) Device according to claim 13, wherein the processing means further comprises means for performing a time smoothing of the energy of one of said first and second versions of the speech signal, and means for comparing the energy of said version and the smoothed energy.

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1 18. (Currently Amended) Device according to claim 17, wherein the processing means  
2 comprise a voice activity detection automaton having a plurality of states including a speech  
3 state and a silence state, means for controlling transitions of the voice activity detection  
4 automaton from the speech state to the silence state based on a comparison between the energy  
5 of said ~~version~~ one of said first and second versions and the smoothed energy, and means for  
6 controlling transitions of the voice activity detection automaton from the silence state to the  
7 speech state based on a comparison of the ~~two different~~ first and second versions of the speech  
8 signal.

1 19. (Cancelled)

1 20. (Currently Amended) Device according to claim ~~[[19]]~~ 13, wherein the processing  
2 means further comprises means for performing a time smoothing of the energy of each of the  
3 ~~[[two]]~~ first and second versions of the speech signal, by means of a smoothing window  
4 determined by comparing an energy of the second version ~~of the two versions~~ with the smoothed  
5 energy of the second ~~of the two versions~~ version.

1 21. (Previously Presented) Device according to claim 20, wherein the smoothing window is  
2 an exponential window defined by a forgetting factor.

1 22. (Currently Amended) Device according to claim 21, wherein the processing means  
2 further comprises means for allocating a substantially zero value to the forgetting factor when the  
3 energy of the second version ~~of the two versions~~ is less than a value of the order of the smoothed  
4 energy of the second ~~of the two versions~~ version.

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23. (Currently Amended) Device according to claim 22, wherein the processing means further comprises means for allocating a first value substantially equal to 1 to the forgetting factor when the energy of the second ~~of the two versions~~ version is greater than said value of the order of the smoothed energy multiplied by a coefficient bigger than 1, and for allocating a second value lying between 0 and said first value to the forgetting factor when the energy of the second ~~of the two versions~~ version is greater than said value of the order of the smoothed energy and less than said value of the order of the smoothed energy multiplied by said coefficient.

24. (Currently Amended) Device according to claim ~~[[19]]~~ 13, wherein the first and second fractions correspond substantially to attenuations of 10 dB and 60 dB, respectively.

25. (Currently Amended) Device according to claim 13, wherein the comparison of the ~~two different~~ first and second versions of the speech signal is performed on respective differences between the energies of said ~~two~~ first and second versions in said frequency band and a lower bound of the energy of the denoised version of the speech signal in said frequency band.

26. (Cancelled)

27. (Currently Amended) A computer program product, loadable into a memory associated with a processor, and comprising portions of code for execution by the processor to detect voice activity in an input digital speech signal in at least one frequency band, whereby the voice activity is detected on the basis of an analysis comprising the step of comparing two different versions of the speech signal, wherein ~~at least one of said versions is a denoised version obtained by taking account of estimates of noise included in the signal~~ the two different versions of the speech signal are two versions denoised by non-linear spectral subtraction, wherein a first of the two versions is denoised in such a way as not to be less, in the spectral domain, than a first fraction of a long-term estimate representative of a noise component included in the speech signal, and the second of the two versions is denoised in such a way as not to be less, in the spectral domain, than a second fraction of said long-term estimate, smaller than said first fraction.

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1 28. (Previously Presented) A computer program product according to claim 27, wherein said  
2 comparison is performed on respective energies, evaluated in said frequency band, of the two  
3 different versions of the speech signal, or to a monotonic function of said energies.

1 29. (Previously Presented) A computer program product according to claim 27, wherein said  
2 analysis further comprises a time smoothing of the energy of one of said versions of the speech  
3 signal, and a comparison between the energy of said version and the smoothed energy.

1 30. (Previously Presented) A computer program product according to claim 29, wherein the  
2 comparison between the energy of said version and the smoothed energy controls transitions of a  
3 voice activity detection automaton from a speech state to a silence state, and wherein the  
4 comparison of the two different versions of the speech signal controls transitions of the detection  
5 automaton from the silence state to the speech state.

1 31. (Cancelled)

1 32. (Currently Amended) A computer program product according to claim ~~[[31]]~~ 27,  
2 wherein said analysis further comprises a time smoothing of the energy of each of the two  
3 versions of the speech signal, by means of a smoothing window determined by comparing the  
4 energy of the second of the two versions with the smoothed energy of the second of the two  
5 versions.

1 33. (Previously Presented) A computer program product according to claim 32, wherein the  
2 smoothing window is an exponential window defined by a forgetting factor.

1 34. (Previously Presented) A computer program product according to claim 33, wherein said  
2 analysis further comprises the step of allocating a substantially zero value to the forgetting  
3 factor when the energy of the second of the two versions is less than a value of the order of the  
4 smoothed energy of the second of the two versions.

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1 35. (Previously Presented) A computer program product according to claim 34, wherein said  
2 analysis further comprises the steps of allocating a first value substantially equal to 1 to the  
3 forgetting factor when the energy of the second of the two versions is greater than said value of  
4 the order of the smoothed energy multiplied by a coefficient bigger than 1, and allocating a  
5 second value lying between 0 and said first value to the forgetting factor when the energy of the  
6 second of the two versions is greater than said value of the order of the smoothed energy and less  
7 than said value of the order of the smoothed energy multiplied by said coefficient.

1 36. (Currently Amended) A computer program product according to claim ~~[[31]]~~ 27,  
2 wherein the first and second fractions correspond substantially to attenuations of 10 dB and  
3 60 dB, respectively.

1 37. (Previously Presented) A computer program product according to claim 27, wherein the  
2 comparison of the two different versions of the speech signal is performed on respective  
3 differences between the energies of said two versions in said frequency band and a lower bound  
4 of the energy of the denoised version of the speech signal in said frequency band.

1 38. (Cancelled)